GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Posted 8/8

Date: September 10, 1976

No prop. Actions OHL

Project Title: Computer Analysis of Methods for Measuring Production of Aquatic Animals

Project No: C-10-631 (Continued by G-32-633)

Project Director: Dr. A.C. Benke

Sponsor: National Science Foundation

Effective Termination Date: 8/31/76

Clearance of Accounting Charges: 8/31/76

Grant/Contract Closeout Actions Remaining: None

- _ Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ______________________

Assigned to: ERC (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director—EES
Accounting Office
Procurement Office
Security Coordinator (OCA) ✓
Reports Coordinator (OCA)

Library, Technical Reports Section
Office of Computing Services
Director, Physical Plant
EES Information Office
Project File (OCA)
Project Code (GTRI)
Other ______________________

CA—4 (3/76)

C-10-631

GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF INTERDISCIPLINARY PROGRAMS

205 OLD CIVIL ENGINEERING BUILDING

ATLANTA, GEORGIA 30332

ENVIRONMENTAL RESOURCES CENTER
(404) 894-2375

BIOENGINEERING CENTER
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August 24, 1976

Dr. J. Thomas Callahan
Associate Program Director
Ecosystem Studies Program
National Science Foundation
Washington, D.C. 20550

Subject: Annual Technical Letter -- BMS75-03151

Dear Dr. Callahan:

This letter represents our annual technical letter for NSF grant BMS75-03151 entitled "Computer analysis of methods for measuring production of aquatic animals, " from the period 1 January 1975 to present.

We have been successful in simulating the growth of hypothetical populations of freshwater invertebrates under a variety of conditions. We are able to vary size-specific growth rates, size-specific mortality rates, and degree of developmental synchronization. For any given simulation, survivorship for each instar is plotted and total actual production is calculated according to size-specific biomass conversion factors. A subprogram "samples" the population at prescribed intervals during the simulation. This sample data is then utilized in each of the four common field methods for estimating secondary production: instantaneous growth, Allen curve, removal-summation, and the Hynes method.

Our results to date show that errors usually increase in all methods used as development becomes less synchronous, and as growth becomes more non-linear. Errors are much larger under certain mortality schedules than others. To illustrate, the enclosed figure shows different mortality schedules for a population which has eight instars. The enclosed table shows estimated and actual turnover ratios (production/average standing stock) for each mortality case in a univoltine population with extremely synchronous development and linear growth. For certain mortality cases, all methods are quite accurate. Errors are higher in all methods for cases 1-.80, 2, 4 and 6. In other simulations in which there is less synchrony and growth is non-linear, underestimates are greatly compounded, particularly in these latter mortality cases. Production is frequently underestimated by a factor of three. Annual turnover ratios of 40 are easily generated. Such a turnover ratio is much higher than commonly reported values from field data. So far, our simulations suggest that all methods will usually underestimate annual production, and under certain combinations of mortality, growth and developmental synchrony, these underestimates can be quite large.

It was our intention to make field verifications of our computer findings by more in-depth analysis of an ongoing project on secondary production in the Satilla River. Unfortunately, our simulations went very slowly the first year due to continual shutdowns of a new computer at the University of Georgia. As a result, we were not able to design experiments or sample populations in ways suggested by simulation output. Therefore, our field work consisted of sampling invertebrates more frequently in the summer of 1975 and conducting invertebrate colonization studies during the summers of 1975 and 1976. These data are now being analyzed and we anticipate they will enhance our understanding of secondary production in the Satilla. They will also provide a data set of several kinds of invertebrate life histories which will be very useful in helping understand the significance of the computer simulations. Hopefully, the combination of computer and field studies will either lead to a new method for estimating production or enable us to correct for underestimates in current methods.

As a result of our work to date,a paper (see below) has been presented at a national meeting and a paper has been accepted for publication. We also anticipate submitting a paper on the first phase of our computer simulations in about a month.

Benke, A.C. and J.B. Waide, 1976. Computer analysis of methods for measuring production of freshwater benthos. Bull. Ecol. Soc. Amer. 57: 42 (abstract of paper presented at the 1976 AIBS Meeting, New Orleans, Louisiana).

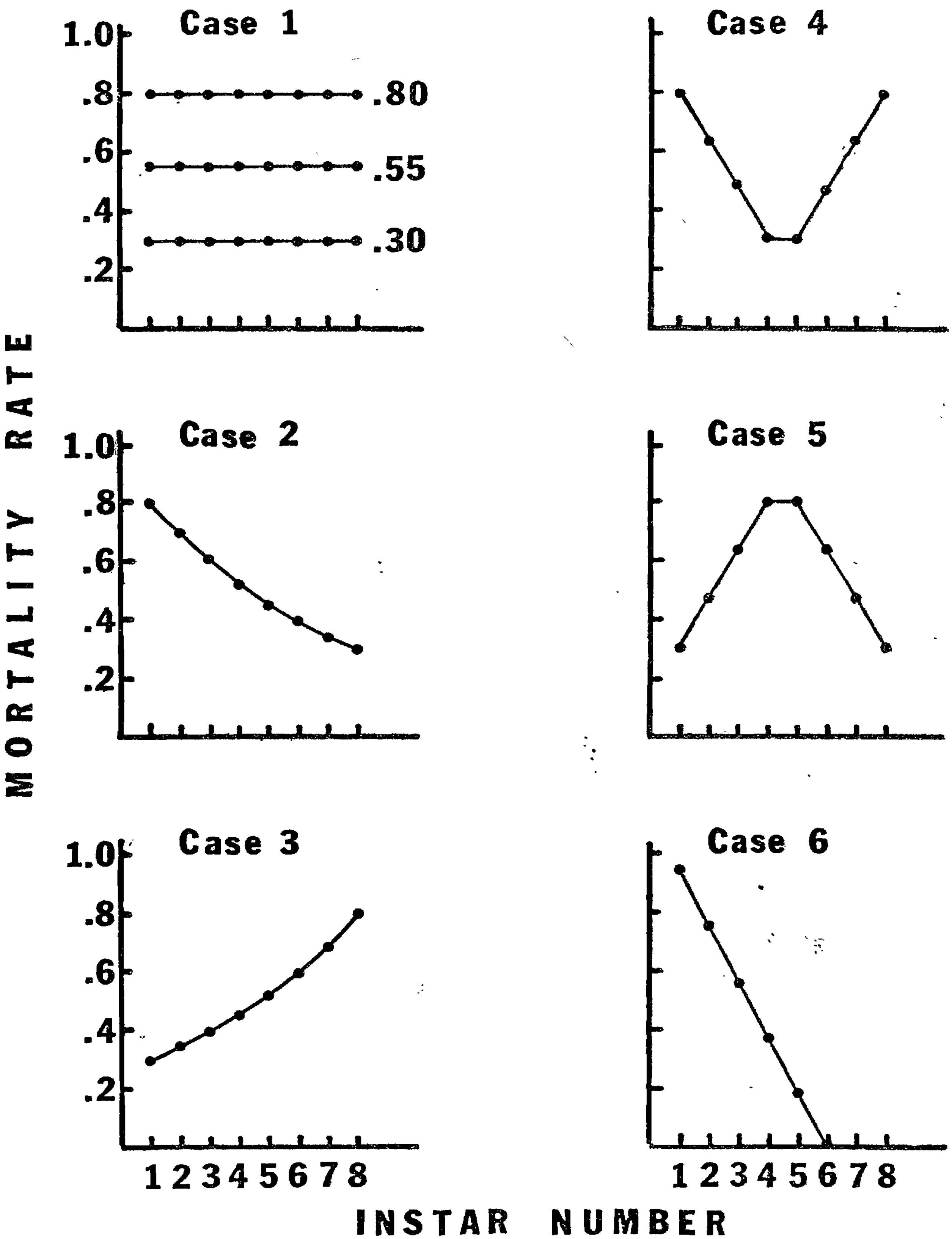
Benke, A.C. and J.B. Waide, 1977. In defense of average cohorts. Freshwater Biology 7 (in press).

If you require any further information on our progress to date, please let us know.

Sincerely yours,

Arthur C. Benke
Assistant Professor

ACB/ta



Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
1.0
.8
.6
.4
.2
.80
.55
.30
MORTALITY RATE
1 2 3 4 5 6 7 8
INSTAR NUMBER

TURNOVER RATIOS FOR POPULATIONS WHICH HATCH OVER A 7-DAY INTERVAL AND SPEND EQUAL AMOUNTS OF TIME IN EACH INSTAR

MORTALITY CASE	TURNOVER RATIO				
	ACTUAL	REMOVAL-SUMMATION	INSTANTAN. GROWTH	HYNES-COLEMAN	ALLEN CURVE
1 - .30	7.31	6.75	6.47	5.70	7.58
1 - .55	9.08	8.57	6.71	6.96	8.83
1 - .80	17.04	12.79	6.36	9.46	14.97
2	11.75	9.53	6.47	7.55	7.57
3	7.80	7.72	6.84	6.39	8.18
4	10.06	8.65	6.68	7.01	7.69
5	9.05	8.90	6.78	7.07	10.92
6.	14.72	8.91	6.02	7.23	5.31